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UNECE

Occupational safety and health in the future of forestry work

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Occupational safety and health in the future of forestry work

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FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
INTERNATIONAL LABOUR ORGANIZATION
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Cover photograph: A South African worker in training to operate a forwarder. © CMO Group

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Foreword

Climate change, demographic transitions, technological developments and innovation are megatrends affecting forestry work. As the conditions of forestry work change, so does the nature of the work-related risks. Despite efforts and improvements made over the past few decades, forests continue to be one of the most hazardous industrial workplaces, with those working in forests exposed to considerable occupational safety and health (OSH) risks as well as to a high incidence of occupational accidents and work-related diseases.

The 2022 edition of the FAO report, The State of the World's Forests, showed that total employment in the forest sector in 2019 was estimated to be 33 million formal and informal employees, out of which almost 8.1 million in the forestry and logging subsector. These figures are likely to increase with interventions set to implement forest-based pathways for resilient and low-carbon economies. Work in forestry can be an important driver of sustainable and inclusive growth and development, as labour income supports a variety of economic activities, especially in rural areas. By promoting a safe and healthy working environment in forestry work, we can contribute to reducing poverty in all its dimensions and promoting equality, in particular gender equality.

In view of recent transformations in forestry work, and taking into account the recent inclusion of a safe and healthy working environment in the ILO's framework of fundamental principles and rights at work, this report identifies trends and opportunities as well as challenges to promote safe and healthy working conditions in the forest sector. It contributes to understanding the importance of decent and sustainable work in forestry, with the objective of informing the design and implementation of policies and training programmes to advance a just transition in forestry following the framework of the 2030 Agenda for Sustainable Development, particularly Sustainable Development Goals 8 on decent work and economic growth and 15 on life on land.

This report has been produced jointly by the Food and Agriculture Organization of the United Nations (FAO), the International Labour Organization (ILO) and the United Nations Economic Commission for Europe (UNECE). These organizations share a long history of collaboration on topics related to forest sector employment, dating back to at least the establishment of the Joint ILO/UNECE/FAO Committee on Forest Working Techniques

and Training of Forest Workers in 1954. We welcome the continuation of this collaboration and hope that this long-standing and fruitful relationship will continue for years to come.

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Acronyms and abbreviations

EEA	European Environment Agency
ESMAP	Energy Sector Management Assistance Program
EU-OSHA	European Agency for Safety and Health at Work
FAO	Food and Agriculture Organization of the United Nations
FLEGT	Forest Law Enforcement, Governance and Trade
FSC	Forest Stewardship Council
GIS	geographic information system
GPS	global positioning system
HRW	Human Rights Watch
ICT	information and communication technologies
ILO	International Labour Organization
IPCC	Intergovernmental Panel on Climate Change
MSMFE	micro, small and medium forest enterprises
OSH	occupational safety and health
PEFC	Programme for the Endorsement of Forest Certification
PPE	personal protective equipment
SME	small and medium enterprises
SDG	Sustainable Development Goal
UKFISA	UK Forest Industry Safety Accord
UN-DESA	United Nations Department of Economic and Social Affairs
UNECE	United Nations Economic Commission for Europe
UNHCR	United Nations High Commissioner for Refugees

Executive summary

A safe and healthy working environment is fundamental to decent work. A sustainable future for forestry work can only be ensured by building safe and healthy environments where occupational safety and health (OSH) regulations and management systems are in place, and are respected and applied. Building such environments requires education, training and life long learning opportunities as well as decent working conditions, supported by effective social dialogue guaranteed for all.

Transformative change, driven by megatrends such as globalization, demographic shifts, technological developments and climate change, is having a significant impact on the future of forestry work and OSH conditions in the sector. The forestry workforce of tomorrow will build on innovations, rural and urban connections and will forge new links with science and technology. Ensuring a future that embraces equal opportunities for all, including women, young people, indigenous and tribal peoples, migrant workers and others, will depend on the ongoing adaptation of long-term education and training plans based on assessments of needed skills; and it will entail fostering a greater understanding of working conditions and forest careers among youth. The transition should develop continuously and organically, based on the specific context of those transformative drivers in the world of work. However, to succeed, the process will also require the coordinated support of all actors involved in forest work to bring about systemic change.

This report provides insight into the way these transformative drivers of change will affect the future of work in forestry. It also looks at policy and training responses to ensure a just transition. The report examines the implications, challenges and opportunities of new and emerging trends in the sector with particular emphasis on OSH, and sheds light on elements that will inform policy design and training programmes. The following are some of the elements presented in the report:

- Climate change is exacerbating health and safety risks for forestry workers particularly for those who work outdoors for extended periods. They are increasingly exposed to occupational accidents and injuries because of forest fires and extreme weather events. Outdoor work increases the risk of heat stress and other weather-related challenges that contribute to fatigue and affect concentration levels. The competitive nature of the sector puts pressure on workers to maintain their productivity even in extreme weather conditions, and this further contributes to psychosocial strains on workers.

- Demographic trends are creating an ageing forestry workforce in some parts of the world and an influx of young workers in other parts. Alongside other shifts, such as the increasing participation of women, ethnic minorities, workers in the informal economy and migrant workers, this is creating additional OSH considerations for forestry. Effectively dealing with these changing work issues requires different approaches that relate to such aspects as the length of shifts, adapting OSH training to different demands, customizing training and providing adequate personal protective equipment (PPE), among other issues.
- The increasing mechanization of work processes and availability and use of new machinery and tools, as well as the emergence of new and innovative technologies such as robotics and artificial intelligence, create new opportunities and allow forest industries to adapt and transform by using these tools. In terms of safety and health, information and communication technologies (ICT) can be used to improve the OSH environment in various ways such as: introducing remote controls to improve the safety of tools and machines, using virtual simulations to train for risk situations, adopting a global positioning system (GPS) for expediting accident responses, or making use of drones for labour inspections. These and other increasingly sophisticated applications of modern technology in forest work will proliferate in the future.

International labour standards lay down the basic minimum social standards for decent work, agreed upon globally by governments, workers and employers. While there is no specific international labour standard on forestry, many International Labour Organization (ILO) Conventions and Recommendations, including those on OSH, apply to forestry (see Box 5). Furthermore, the ILO has specific guidance on safety and health and on labour inspection in forestry, which can provide additional guidance to the sector. This report stems from collaborative research undertaken by the Food and Agriculture Organization of the United Nations (FAO), the International Labour Organization (ILO) and the United Nations Economic Commission for Europe (UNECE) that looks into the challenges and opportunities related to OSH in forestry work with the objective of providing insight into possible ways in which these emerging issues could be addressed effectively.

The following are the key messages of this report:

- Forestry will see some tasks and occupations be transformed or disappear due to climate change, technology and other drivers shaping the sector. There are opportunities to generate new jobs and to contribute towards both a green economy and decent work if a responsive transition framework addressing training and skills development needs is developed. Social dialogue is an invaluable tool for designing and implementing policies and training programmes to advance towards a just transition.

- Climate change will change forest jobs and the skills needed for them. Forest fires, weather hazards, pests and tree diseases will present new challenges that will require workers with specific skills as well as new kinds of equipment and people to operate them. Forest managers and workers, governments and communities will have to work together to adopt new technological solutions and training.
- Women make up an estimated 25 percent of the global forestry work force. In Europe, 20 percent of forestry workers are women. They are often over-represented in unpaid and low paying jobs, including in the informal economy. Including more women in education, professional training, safety training courses and decision-making can considerably reduce the number and degree of occupational hazards and create personal and professional development opportunities. Developing a better understanding of the role of women in forestry and designing gender-responsive training are essential to securing safe working conditions and for promoting opportunities for women, while also addressing specific OSH risks. Particular attention should be given to activities related to non-wood forest products and other areas in which women are particularly active.
- The work arrangements used in forestry can worsen the challenges already present in the sector. Seasonal, temporary, part-time and contractual work may in some instances be inadequately covered by labour regulations and inspections; and workers may lack access to social protection. Temporary and seasonal workers may be more exposed to various types of safety hazards, such as difficult working conditions and repetitive tasks related to a higher risk of accidents and injuries, psychosocial issues, harassment and fatigue. Compliance monitoring, clarification and education programmes are important tools to mitigate these risks.
- Much forestry work takes place in the informal economy. This often leaves workers less protected than those in the formal economy, as they may work in informal enterprises or as unregistered informal workers. Decent work deficits such as poor and unsafe working conditions, obstacles to the right to freedom of association and the effective recognition of the right to collective bargaining, inadequate OSH measures, low productivity, low wages, and a lack of access to social protection are commonplace among workers in the informal economy in forestry. Cooperatives and other forms of forest owner and producer organizations can promote adequate OSH measures by providing PPE and relevant training on appropriate use, and by supporting the formalization of workers and economic units.
- Communities and smallholders in some regions often lack information about, and access to, PPE and as such are at a higher risk of injury. In addition, equipment used by operators is often obsolete or worn out. For

example, chainsaws with ineffective chain brakes or vehicles transporting timber that are poorly maintained and unfit for the purpose. Adequate training and provision of information are key to addressing these issues, alongside ensuring fair incomes for small operators who can then make investments to improve OSH and productivity where needed.

- The ILO Declaration on Fundamental Principles and Rights at Work (1998), as amended in 2022, includes safe and healthy working conditions as one of its five categories, with the Occupational Safety and Health Convention, 1981 (No. 155) and the Promotional Framework for Occupational Safety and Health Convention, 2006 (No. 187) considered as fundamental conventions.
- International labour standards lay down the basic minimum social standards for decent work, agreed upon globally by governments, workers and employers. Duly implemented, coherent and effective legislative and regulatory frameworks aligned with international labour standards are a precondition for advancing safe, decent and sustainable work as well as a just transition in forestry.
- Social dialogue based on respect for freedom of association and the effective recognition of the right to collective bargaining is key to promoting decent and sustainable work including safe working conditions in forestry.
- The principles of a just transition, which combine environmental objectives with decent work objectives and are based on social dialogue, offer the path forward to address and mitigate the impacts of climate and environmental change and to improve the safety and well-being of forestry workers around the globe.
- Skills development is key to improving productivity and the sustainability of enterprises and to ensuring safe forestry operations. New workers entering the sector will need appropriate training and skills development while existing workers will need upskilling and re-skilling that takes into consideration the specific needs of different groups of workers.
- Ensuring gender-responsive approaches to OSH and empowering women by supporting their participation in decision-making processes will improve their working conditions in forestry and provide new opportunities. Similarly, providing tailored approaches and support to groups of workers such as young, elderly, migrant workers, those in the informal economy, and indigenous and tribal peoples, is important to ensuring productive, safe and sustainable forestry that leaves no one behind.
- The lack of reliable and comparable statistical data and research on occupational accidents and work-related illnesses persists. This makes it challenging to develop and implement evidence-based policies

and response strategies to address these issues. The high incidence of informality creates further challenges concerning the reporting, availability and reliability of data. Efforts should be made to collect and compile disaggregated statistical data on employment and occupational accidents in forestry.

1. Introduction

"Decent work sums up the aspirations of people in their working lives. It involves opportunities for work that is productive and delivers a fair income, security in the workplace and social protection for all, better prospects for personal development and social integration, freedom for people to express their concerns, organize and participate in the decisions that affect their lives and equality of opportunity and treatment for all women and men." (ILO, 2022a).

Decent work in forestry is fundamental to ensuring that forestry operations are sustainable, productive and environmentally friendly. The working environment must be safe for workers and it must benefit the millions of people who depend on forests for their livelihoods, food and shelter. Despite the efforts and improvements made over the past few decades, forestry work remains hazardous for many of the workers in the sector (ILO, 2019a). At the same time, forests and forestry play a dual role in relation to one of the biggest challenges of our time: climate change. While deforestation and forest degradation are major generators of greenhouse gas emissions, sustainable forest management also has the capacity to provide major long-term mitigation benefits.

Work in forestry is undergoing transformative change that is being driven by megatrends such as globalization, demographic changes, technological developments and climate change. These megatrends affect entire work systems that change the composition of the workforce and skills workers need as well as the technology used in workplaces, the organization of work, and the social and economic environments. The COVID-19 pandemic brought about new challenges to work in forestry while exacerbating existing problems, including in the areas of occupational safety and health (OSH) and rights at work, thus underscoring the need to strengthen safety and health measures (ILO, 2021b). The impacts and extent of these transformations vary among countries and regions depending upon various aspects such as forest types, technologies and techniques used, types of operations and other characteristics. This diverse range of circumstances provides new opportunities but also brings challenges that need to be understood and addressed to help facilitate a safe, sustainable and human-centred recovery in the sector.

The lack of decent work in forestry in many parts of the world remains a problem, one that has been worsened by the COVID-19 crisis. The issues include poor and unsafe working conditions, obstacles to freedom of association and the effective recognition of the right to collective bargaining, low productivity, low wages, lack of access to social protection, and inadequate OSH measures. These deficits are more pronounced among those working in the informal economy, many of whom are women (ILO, 2019a).

> A preventative safety and health culture "… refers to a culture in which the right to a safe and healthy working environment is respected at all levels, where government, employers and workers actively participate in securing a safe and healthy working environment through a system of defined rights, responsibilities and duties, and where the principle of prevention is accorded the highest priority."
>
> (Art. 1[d] of the Promotional Framework for Occupational Safety and Health Convention, 2006 [No. 187])

Work in forests is associated with inherently high OSH risks, primarily related to the use of heavy machinery, falling trees, climatic hazards, noise, vibration, non-ergonomic working postures, stress and strain, as well as exposure to various chemical and biological substances. Therefore, preventing accidents and reducing health hazards are important features of the research on forest operations and forest engineering. While the risks to the safety and health of forestry workers have been analysed and documented for decades, there is a persistent lack of reliable and comparable statistical data and research on both fatal and non-fatal accidents as well as work-related illnesses. This makes it difficult to develop and implement evidence-based policies and response strategies to address these issues. The high incidence of informality in the workforce creates further challenges concerning the reporting, availability and reliability of data.

Available data shows that, within forestry, accident rates are highest in logging activities, namely in felling trees, lifting and extracting logs as well as in repairing and maintaining tools and machinery. Many accidents occur when transporting timber and when workers travel to remote sites. In silvicultural activities, accidents are both less frequent and less serious; however, some are still relatively common, such as slipping, falling and cuts involving sharp tools and hand-held machines (ILO, 2005). These issues are compounded by the fact that silvicultural work is carried out in the open, exposing workers to extreme weather conditions, including heat stress, and often involves handling chemicals that may also cause illness. Generally, it is the unskilled workers, who are often seasonal, young workers and those new to the profession who have the most accidents (Poschen, 2011).

A high proportion of forestry work is undertaken by small enterprises and by self-employed workers, including private forest owners. This poses high OSH risks and hazards owing to the low quality and/or misuse of work and safety equipment, the limited skills and experience of workers and the workers' lack of awareness of, and training in, managing safety and health hazards. Many accidents in small-scale operations go unreported as they are often not covered by accident insurance nor are they recorded through other systems used to collect such statistics (ILO, 2005).

Safe and healthy working conditions are fundamental to decent work. The COVID-19 pandemic has laid bare the vulnerabilities of forestry workers, particularly those working in the informal economy, and exposed them to new and exacerbated OSH risks. In doing so, it has served as a reminder of the crucial need to make OSH in forestry a priority area in national policies. Duly implemented, coherent and effective legislative and regulatory frameworks aligned with international labour standards are a precondition for advancing safe, decent and sustainable work as well as a just transition in forestry. Effective social dialogue between governments and organizations for workers and employers will continue to play a crucial role in addressing the safety and health concerns that currently exist in forestry, as well as adapting to and mitigating against those that will arise in the future.

> Social dialogue includes all types of negotiation, consultation and exchange of information between or among representatives of governments, employers and workers on issues of common interest relating to economic and social policy (ILO, 2018a).
>
> Effective social dialogue and sound industrial relations are means to promote social justice, inclusive economic growth, improved wages and working conditions, and sustainable enterprises (ILO, 2022b).

Scope and objectives

The objective of this report is to look at transformations shaping the future of work in forestry and at the implications, challenges and opportunities they present for OSH in forestry at the global level, with a view to ensuring a safe and healthy future for forestry workers. It focuses on work in forestry production, which is defined as the production and harvesting of wood and non-wood forest products.[1] Therefore, it covers labour-related issues in forestry

[1] The definition corresponds to ISIC, Rev.4/NACE, Rev.2 activity A02 forestry and logging, including silviculture and other forestry activities, logging, gathering of non-wood forest products, and support services to forestry. In line with FAO's definition, this excludes "tree stands in agricultural production systems, such as fruit tree plantations, oil palm plantations, olive orchards and agroforestry systems when crops are grown under tree cover …" (FAO, 2022).

operations such as site establishment and preparation, harvesting, and road transport to and from the site. It covers work on products that undergo little processing such as firewood and charcoal and includes gathering non-wood forest products as well as services to forestry, both in the formal and informal economy. Each chapter of the report focuses on one transformation that is shaping the future of OSH in forestry including: climate change, demographics and technological developments. The research was conducted through a study of the available literature and was complemented by contributions from forest technology experts.[2]

Photo 1. Widespread and scattered fires in Mustang Complex, Idaho, United States of America, 2012.

© Kari Greer

[2] FAO sent a short questionnaire to numerous forest technology experts in April 2021 and received 23 responses from 17 countries on 5 continents. The information from these responses was used to provide background on the impacts of megatrends on forestry at the country level.

Since study resources and statistical data in some regions are limited, this report does not present an all-inclusive overview of research topics and statistical data related to OSH trends. Some regions are more extensively documented in the scientific literature.

Box 1.
The COVID-19 pandemic and its implications for occupational safety and health in forestry

The COVID-19 pandemic has had an impact on the world of work in forestry. In the early months of the pandemic, the demand for forest and wood products temporarily declined in some regions and countries, and many companies had to halt their activities or close down temporarily, leaving workers in vulnerable situations including migrant workers (ILO, 2020a). Since then, the production and trade levels have increased, in some cases even above pre-pandemic levels (UNECE and FAO, 2021).

In addition to its effect on enterprises and the livelihoods of workers, the COVID-19 pandemic has created new OSH risks for forestry workers and exacerbated many existing ones, such as psychosocial risks. Ensuring safe workplaces and preventing the spread of viruses has become even more important in light of the pandemic, which has highlighted the need for everyone at the worksite to be aware of the risks and to know how to prevent, control and mitigate them (ILO and FAO, 2020). It has also highlighted the importance of ensuring that the different phases of risk assessment and response processes are based on workplace cooperation and social dialogue (ILO, 2021a).

While forestry work is primarily undertaken outdoors, there are still issues to be considered concerning the prevention and control of viruses such as COVID-19 and to ensuring resilient OSH systems to better prepare for future crises. Ensuring good industrial hygiene practices, including disinfecting shared tools and promoting appropriate personal hygiene practices, are indispensable as is providing personal protective equipment (PPE) where necessary (including masks, sanitizer products, etc.). Similarly, restricting and monitoring site access and ensuring the safe transportation of workers can help to address safety and health risks such as viruses.

Forestry work is sometimes organized around work camps which create their own specific risks. For example, accommodation, recreation and sanitation facilities should be organized safely, allowing for sufficient physical distancing. Performing regular health self-checks can help identifying symptoms and cases early on.

2. Changing forestry jobs in a changing climate

As climate change, technology and other drivers shape the sector, forestry will see some tasks and occupations be transformed or abandoned and new ones created. There are opportunities for generating new jobs in forestry which, if aligned with the just transition framework, could contribute towards creating both a green economy and decent work. The global demand for wood is likely to increase, including in sectors such as construction, furniture manufacturing and packaging. It is also likely to increase in innovative applications of cellulose-based fibres, such as for producing textiles, hygiene products and bioplastics that are promoted as sustainable solutions supporting the transition towards a bio-based circular economy. The industry will need to find ways to sustainably meet this growing demand (UNECE and FAO, 2022). Forest-based tourism and recreation also have the potential to grow and protected forest areas are increasing in many parts of the world. This will create a demand for new jobs associated with forest-based recreation and the need to protect both forests and wildlife. Jobs related to monitoring and verifying carbon stocks, biodiversity and other forest ecosystem services will be created, while collecting non-wood forest products is likely to remain an important source of income for many. Reforestation, afforestation, and forest restoration all contribute towards carbon capture and climate mitigation efforts. Developing carbon sinks and carbon capture through such activities could create significant employment, including green jobs and new growth opportunities (ILO, 2018b).

Ensuring the sustainability of these and other new types of forest-related jobs will require effective policies and responses to guarantee a just transition for forestry workers and enterprises. Such a transition addresses environmental and climate change concerns, creates decent work opportunities and leaves no one behind. These new jobs will come with specific and often new types of OSH challenges. Such jobs will require appropriate training and skills development for new workers entering the sector while helping the existing workforce to upgrade their skills and acquire new ones. New recruits and workers carrying out new tasks will require adequate training with high standards in terms of performance and safety. Social dialogue is an invaluable tool for designing and implementing policies and training programmes to advance towards a just transition.

The effects of climate change disproportionately affect those in poverty and can exacerbate economic, gender and other social inequalities (UN, 2021). A move towards a net zero and climate resilient future calls for a just transition towards a more sustainable, resilient, and inclusive economy that addresses environmental and climate change concerns in a way that is as fair and inclusive as possible to everyone concerned, creating decent work opportunities and leaving no one behind.

Climate change is having a tremendous effect on forests and forestry, as highlighted by the increased frequency and intensity of storms, wildfires and pest outbreaks, among other things (IPCC, 2018). If sustainably managed, forests have the potential to help reverse the adverse impacts of climate change and contribute to mitigation and adaptation (IPCC, 2019). However, extreme weather events induced by climate change along with their related consequences such as pest outbreaks, present new challenges for forestry work and workers worldwide. Strengthening OSH management systems to deal with new, existing and changing OSH challenges must be carried out in line with the principles of a just transition towards environmentally sustainable economies and societies for all (ILO, 2015).

Rising temperatures and heat stress

Heat stress is an OSH hazard with significant effects on both productivity and the safety and health of workers (ILO, 2018b), especially with climate change increasing both air temperature and humidity. This will make outside work and many forestry activities increasingly difficult and even impossible in some areas of the world for at least part of the year. Extreme temperatures, both high and low, are linked to an increased risk of occupational injuries (Boxall *et al*., 2018; Bonafede *et al*., 2016). Exposure to high temperatures can decrease the physical performance of forestry workers as well as their concentration levels. Direct exposure to sunlight for extended periods can lead to additional risks such as skin cancer and eye damage.

Adding to the challenges of working in hot and humid conditions, forestry workers are often required to wear heavy work gear and PPE to protect them from various work-related hazards, further increasing the risk of heat stress (Staal, 2018). Increased temperature and humidity also contribute to fatigue, a hazard that significantly contributes to workplace accidents (Sadeghniiat-Haghighi and Yazdi, 2015). Fatigue affects both the mental and physical capacity of workers, slowing their reaction times and affecting their decision-making abilities. Apart from the direct impact on safety and the rate of accidents, extreme temperatures can cause health issues such as dehydration, heatstroke or even loss of consciousness with older workers at increased risk.

Box 2.
Climate change and occupational safety and health in forestry

Climate-related factors that may affect OSH in forestry include:

- the extent of warming in different regions;
- changes in seasonal patterns, e.g. frozen ground thawing in the northern hemisphere may necessitate a change in harvesting plans, and wildfire seasons are likely to continue to lengthen and intensify;
- fires affecting inhabited areas and requiring the felling of snags (creating hazardous work when using chainsaws, for example);
- changes in soil moisture creating an increased risk of landslides;
- more frequent and more intense extreme weather events requiring potentially dangerous salvage operations;
- the increased occurrence of snags, trees affected by pests and trees blown over in storms that must be dealt with via logging operations, which create safety hazards especially in motor-manual logging operations;
- the impact of heat stress and fatigue, particularly upon an ageing workforce;
- the availability of PPE adapted to warmer and more humid conditions and of equipment adapted for women;
- the availability of training for workers and the self-employed; and
- providing training on climate-related OSH challenges to ensure the safety of the workforce.

Heat stress tends to be more prevalent in countries with high levels of working poverty and informality, and therefore often affects workers who are already vulnerable (ILO, 2019c). These workers may be less able to slow the pace of their work, take sufficient breaks or access clean drinking water, further increasing their risk of heat stress. Forestry workers may also face an elevated risk of overexposure to ultraviolet radiation as continuous long-term exposure to hot and sunny conditions from a young age increases the risk of developing diseases such as skin cancer later in life (ILO, 2018d).

In some parts of the globe, particularly in the northern hemisphere, warmer winters and shorter periods of frozen ground may lead to OSH hazards by making some roads more difficult to use and in need of more frequent maintenance.

There is a need to assess working environments and to adapt work practices accordingly to protect forestry workers from the impacts of heat waves and high temperatures. This may include modifying work schedules to avoid high risk activities during the hottest periods of the day (EU-OSHA, 2020).

This change in work schedules, with more shifts starting earlier or later in the day, will in turn affect OSH including rest and recovery times, and work-life balance. Furthermore, PPE should be adapted to extreme weather conditions to make it better at: alleviating heat stress and dehydration in hot weather, retaining warmth in cold weather, and protecting against slippage and restriction of movement.

Biological hazards

Increasing temperatures may lead to some insects that carry vector-borne diseases, such as ticks, flies, mosquitoes and fleas, becoming more widespread and active for longer periods of the year. This can result in longer transmission seasons and consequently, higher incidence rates of diseases and the emergence of diseases in new areas. Examples of vector-borne diseases that affect forestry workers include Lyme disease in temperate regions, while malaria and dengue fever remain a threat in tropical areas (Gifford, 2009; ILO, 2005).

Climate change affects a number and range of species. It also affects the vectors and hosts of zoonoses which have already seen a significant expansion (Bartlow *et al.,* 2019; Rochlin *et al*., 2013). In some cases, human activity has also been responsible for transporting vector-borne diseases or creating and modifying habitats and ecosystems, making them more attractive to vectors through such activities as deforestation. Vector-borne zoonoses are responsible for 17 percent of all cases of infectious diseases reported globally and cause 700 000 deaths annually. Furthermore, zoonoses account for 60 percent of all emerging infectious diseases (Naicker, 2011). Forestry workers, particularly those living in camps, are susceptible to being bitten by disease-carrying insects. This situation is exacerbated by increasing temperatures leading to more work being carried out during the dawn and dusk period, thus increasing the risk of contracting mosquito-borne diseases in particular. Furthermore, forestry workers provide an avenue for new zoonoses to enter the general population through the interactions between forest-dwelling and urban populations (Wolfe *et al*., 2005).

Increases in the numbers and ranges of other animals may also bring forestry workers into contact with new hazards, such as various stinging insects or poisonous snakes that begin inhabiting regions previously unsuitable to them. For example, in Argentina, venomous snake species are expected to expand their range by hundreds of kilometres in the coming decades because of warmer conditions (Nori, Carrasco and Leynaud, 2014).

New and increased risks will require employers and/or contractors to take actions to limit their impacts. These include putting in place measures to mitigate and prevent disease incidence and impact, and training workers and first aiders in the treatment of infectious diseases, injuries, etc. Mitigation measures may include physical alterations to accommodation, ensuring the availability and use of PPE that is adequate for mitigating both the risks

posed by new and existing hazards, and keeping stocks of antidotes for onsite treatment.

Forest fires

The scale, intensity and duration of forest fires have been increasing across the world due to climate change and other human-induced factors. Australia, Nepal, the United States of America, and the Amazonian and Siberian regions, for example, have experienced some of the worst fire breakouts in a decade or more during the period 2020–2021 (UN-DESA, 2021). These fires often coincide with droughts and heatwaves which have also contributed to the expansion of fire-prone areas and longer fire seasons in some regions, including in Europe (EEA, 2019).

Forest fires are directly responsible for numerous fatalities globally and cause many other smoke-related injuries and diseases (Sheldon and Sankaran, 2017; Marlier *et al*., 2019). Forest firefighters at the frontline tackling these hazards face significantly increased risks of lung cancer and cardiovascular diseases from smoke exposure, in addition to the risks that arise from exposure to wildfires and extremely high temperatures (Navarro *et al*., 2019).

Forest fires increasingly affect settled areas, making it necessary to remove more standing damaged trees. This is high-risk work, particularly because it may be conducted in damaged urban environments and is difficult to mechanize. Large trees in settled areas may be too big for feller bunchers or harvesters and it may be prohibitively expensive to hire machines to fell a small number of trees. The safety of workers having to fell such trees manually can be improved by using hydraulic wedges but these are not always available.

Photo 2. A logging camp in Suriname. Special care must be taken at camps to control the spread of diseases including COVID-19. Basic medication should be available on site

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Increasing storms and wind speeds

Both tropical and non-tropical storms are expected to increase in frequency and intensity because of climate change (Christensen *et al.*, 2013). Strong tropical cyclones, the most damaging storms, will lead to increased flooding in coastal areas, flooding in inland areas due to excessive precipitation and increased wind damage to trees. Extratropical cyclones are also likely to intensify and add to the need for high-risk salvage logging operations (see Photo 3).

In recent decades, average windspeeds have also been increasing globally (Zeng *et al.*, 2019). This makes forestry work more difficult and more hazardous because of the increased risk of falling trees and the inability to properly direct the line of fall. In much of Canada for example, the number of days per year with wind gusts over 28 km/h is expected to increase by 5 to 10 percent, while the number of days with gusts over 90 km/h is expected to increase by 30 to 100 percent by 2100. High winds will have a negative impact upon safety and health where workers continue to work in forests, and upon productivity where they are withdrawn. Autonomous harvesting machines would reduce the need for workers to be in the forest in high winds but the cost of repairing damage to these expensive machines would probably limit their use in such conditions. On the other hand, increasing wind speeds may in some geographical locations offset the impact of increasing temperatures to some extent by leading to improved cooling outdoors, and contribute to the cooling of properly designed worker accommodation (Davies-Wykes, Chahour and Linden, 2020).

Photo 3. Forest in the Bahamas damaged by flood and wind and prone to further damage

© Claus Eckelmann

Increase in tree mortality

Changes to their physical environments are likely to make trees more susceptible to diseases, while events such as increased droughts will lead to higher tree mortality and further contribute to the risk of forest fires. The changing climate is altering the range of forest pests, and this has led to increased damage to forests in some areas, as seen with the bark beetle outbreak in Central Europe, as well as to impact on human health (Reuters, 2019).

The increase in intensity and frequency of storms, floods, droughts and other natural disasters caused by extreme weather events and climate change may change the patterns of yearly average temperatures. This could lead to warmer summers and milder winters in many countries. Mild winters provide greater scope for insects to spread and may lead to increased infestation outbreaks in habitats that were previously constrained by low temperatures, causing an increase in mortality among susceptible tree species.

Such widespread infestation and the mortality of trees resulting from climate-change-related events will increase the need for salvage logging to clear affected areas, which brings additional risks to forestry workers.

Salvage logging

Extreme events such as strong winds, storms, cyclones, forest fires and floods create large quantities of wood and woody debris that need to be cleared from forests and settlements. Such clearance is necessary to continue forestry operations and in urban environments to allow for the use of roads, waterways, agricultural fields, parks, electric installations and sewage infrastructure, among others. Forest clean-up work or salvage logging following any type of forest disaster requires specific skills and equipment. It is also one of the most dangerous types of work in forestry, as it takes place in highly unpredictable conditions in an inherently unsafe environment and therefore has a high incidence of accidents and injuries both fatal and non-fatal (van Hensbergen and Cedergren, 2020).

Box 3.
Occupational safety and health, and salvage logging

Salvage logging is becoming more common in everyday forestry operations as the frequency and intensity of extreme events increase. Specialized training, the use of PPE and mechanization, where possible, are some of the ways to ensure workers are not put at unnecessary risk when conducting these activities. The expertise of forestry workers may also be needed for reconstruction in some areas and professionalizing the workforce is necessary to meet these challenges.

Cooperation among governments, responsible authorities, organizations for employers and workers, and other forestry stakeholders is a precondition for ensuring safe and effective salvaging operations.

continues

In this regard, the FAO has recommended four steps to promote effective and safe salvage logging:

- General planning and organizing salvage work is important and needs to be done before events occur. This includes training individual responders, responder teams and response hierarchies.
- Providing regional engineering equipment, including forestry equipment, that is readily available for rapid deployment to disaster sites.
- Providing key actors with rapid access to information about the location of critical resources, including contact details of essential forestry staff, the location of required forestry equipment as well as optimal access routes to sites for timber storage.
- Forestry workers must be well-trained in all aspects of the work they will be required to undertake in relation to clearing fallen timber and opening roads.

Source: van Hensbergen, H. & Cedergren, J. 2020. *Forest-related disasters – Three case studies and lessons for management of extreme events*. Forestry Working Paper No. 17. Rome, FAO.

Salvage logging is a particularly risky activity when operations cannot be mechanized, for instance where machinery is not available, the terrain is unsuitable for heavy machinery or the areas are inaccessible. In these cases, cutting with a chainsaw and processing fallen, snapped or hanging trees are especially hazardous tasks. While training for these situations can be provided, it cannot be tailored to the specifics of each event such as the size, shape and location of the debris to be cleared. Furthermore, PPE typically designed for logging is inadequate for salvage logging purposes.

Reforestation and forest restoration

In response to concerns over climate change, deforestation, environmental sustainability and biodiversity conservation, it is likely that there will be more activities to increase the amount, and improve the quality, of forested areas through reforestation, afforestation and forest restoration. This will generate an increased demand for forestry workers to undertake silvicultural activities and forest management. Many new workers in these occupations have little or no experience or training, and many of these jobs are likely to be created in the informal economy.

As natural forests are restored and plantations develop, the tasks carried out at sites will change from initial land preparation activities (for planting or protecting natural regeneration after damage) to site maintenance and the eventual harvest and transport of trees. Given the changing nature of the work, it is increasingly important to provide training and PPE to workers, particularly regarding reforestation carried out by communities and smallholders, as without them workers will be at significant additional risk.

Photo 4. Salvage logging in steep terrain in northern Italy following a major landslide. The use of a modern harvester for salvage logging significantly improves safety at work

Inventory work

Remote sensing technologies play an increasing role in forest inventory work. Field verifications of assessments are important when using such technologies. Inventories of natural forests for example will be conducted in more remote and/or inaccessible areas. This requires higher levels of accident readiness, including through more extensive training for inventory crews in first aid, as well as additional first aid equipment and modern communication technologies for calling for help.

Forest rangers

Forest rangers and others engaged in forest protection play a key role in the conservation and protection of forests and of the broader environment. Forest protection activities are likely to provide more jobs in the future, particularly in natural forests with precious timber and wildlife. However, rangers face several challenges related to their safety and health and rights at work, including the threat of violence from illegal loggers and armed poachers (Belecky, Singh and Moreto, 2019). Improving working conditions, OSH, training opportunities and giving a voice to rangers through effective social dialogue can make forestry a more attractive occupation. The safety of forest rangers can be enhanced through technological solutions such as the use of satellite imagery and web-connected cameras at checkpoints. These tools would also help control the illegal timber and wildlife trade and protect the natural environment as well as workers.

Photos 5 (top) and 6 (bottom). Loading large logs at a landing in Ghana. Loading at the same landing caused a near miss when a log rolled off the truck moments after the truck began to drive away.

3. Demographics and diversity of the forestry workforce

Changes in demographics have a major impact on different regions and occupations, with ageing populations in some parts of the world and growing youth populations in others. This will create both opportunities and challenges for labour markets and this is also true for forestry and its workforce (ILO, 2019d).

Forestry work takes place primarily in rural areas and as a consequence, it is challenging for employers in many countries to recruit new workers particularly young people. While the global population continues to grow, it is doing so at a slower pace than previously. The global rural population was estimated to have reached its peak in 2021, which means that there could be a smaller workforce available in forestry in the future (UN-DESA, 2019).

The forestry workforce is traditionally associated with physically strong and relatively young men, engaged in hard manual labour in challenging natural environments. While this is still true in some forestry activities, particularly logging, the forestry workforce is now composed of women and men of all ages with different backgrounds, qualifications and capacities. This effect is further compounded by migration patterns in the sector as well as other factors. Furthermore, the composition of the forestry workforce differs within and between countries and regions, which has further implications for OSH.

3.1. AGE

Age can be an important factor for OSH and will need to be given due attention to ensure safe working conditions for all forestry workers. Young forestry workers have different OSH needs than older workers. Addressing these needs will benefit not only the workforce but also employers, as it will lead to improvements in both the quality of work as well as productivity.

While data on the impact of age on accident rates in forestry is not widely available, young workers with less training and limited experience in using forestry tools, may be at higher risk in certain aspects of their work than members of other age groups. Conversely, older workers may face increased risks associated with tasks that require sustained physical effort.

Mechanization can enable older employees to remain in their jobs longer, as operating machinery is less physically demanding than manual work. It may, however, create new OSH risks such as ergonomic positioning and

posture issues in the long term. Nevertheless, the overall OSH outcomes of mechanization are likely to be positive with fewer older workers being reluctant to embrace mechanization (Spinelli, personal communication, 2021).

Young workers

Young workers form an important part of the forestry workforce. However, the demands of heavy physical work and a greater susceptibility to accidents and occupational injuries among younger workers are a particular OSH concern. This is due to factors including lower levels of physical, psychosocial and emotional maturity, less work-based education and skills training, limited work experience, inadequate supervision, insufficient information on identifying and managing different risks, and limited representation and voice in the workplace (ILO, 2019e).

Young workers may take unnecessary risks to prove themselves. Younger workers may also lack confidence in highlighting potential safety and health issues. These factors may unnecessarily expose them to OSH hazards, including those related to the use of forest machinery such as chainsaws, working at heights or working with chemicals.

In some countries, the sector struggles to attract young people at all skill levels, as forestry work is often perceived as physically demanding and poorly paid, and as having a bad safety record and low social status. In the United States of America, a career website ranked "logging worker" as the second-worst out of 224 jobs, largely due to the unsafe working conditions (Careercast, 2021). In some European countries, it has been particularly challenging to find students for forestry work that requires high-level qualifications (such as certain machine operators) as well as forest and business managers (FAO and UNECE, 2020). To improve the attractiveness of the sector for young people, it is necessary to improve its reputation, to provide decent and safe working conditions and to demonstrate its capacity to create jobs and careers that support a green economy and a just transition (Garland *et al.*, 2020). Mechanization could contribute to the overall attractiveness of the sector for young workers by reducing accident rates. Furthermore, today's youth are looking for meaningful, safe work that offers acceptable remuneration, provides opportunities to see tasks through from start to finish and encourages them to use different skills and capacities. Additionally, many seek employment where they can have a positive impact on others, enjoy a certain level of autonomy in the workplace and receive regular feedback on the quality of their work (MacQueen and Campbell, 2020).

Improved access to quality education and training, promoting skills development and lifelong learning as well as ensuring access to productive resources can help increase the attractiveness of work in the sector (FAO, 2018). Integrating safety considerations into professional forestry training through practical guidelines for teachers in vocational training institutes, for example,

can help to ensure the mainstreaming of risks management in the workplace, promote OSH and consequently make the sector more attractive to workers (Billoru and Sandoya, 2019).

While attracting young people to the sector can be challenging in some countries, young people in other countries may be willing to work under less-favourable employment terms and with poor working conditions simply to enter into the labour market. They may be overrepresented in the informal sector and in jobs of inferior quality (ILO, 2016).

Ageing workforce

Slowing global population growth and increased life expectancy are leading towards an ageing global workforce and rising statutory retirement ages. In the early 2010s, one-third of forestry workers in Europe were at least 49 years old, while in the western United States of America more than half the sector's workers were over 45 (Forest Europe, 2015; Garland, 2013). The average age of forestry workers is expected to further increase in the coming decades.

While older workers can bring a wealth of experience and knowledge to forestry work, some of their functional capacities may gradually decline as part of the natural ageing process (ILO, 2019e). OSH hazards associated with older workers include diminished physical capacities, slowing reflexes, decreased working memory, increased difficulties with hearing and vision, higher rates of musculoskeletal conditions and chronic diseases (Tamers, Streit and Pana Cryan, 2020). Balance- and agility-related slips and falls, which are common in forestry work, are more frequent among older workers (Westerståhl *et al.*, 2018). Many forestry activities require operating heavy machinery or chainsaws, the physical strain of which is more challenging for older workers than it is for the young. This may lead to or exacerbate issues such as back problems (Kastenholz, Morat and Seeling, 2016). While some workplace risks and issues may be mitigated by their experience, others, such as the more rapid onset of fatigue, may need to be addressed by adjusting workloads and task assignments. Older workers tend to experience fewer injuries overall than younger workers (Albizu-Urionabarrenetxea, Tolosana-Esteban and Roman-Jordan, 2013), however, when injuries and illnesses do occur, they often require longer recovery periods and are more likely to be fatal. The participation rate of older workers in on-the-job training is lower than that of younger workers, often because employers are reluctant to provide expensive training to workers who are unlikely to remain in employment for much longer (ILO, 2018c). The specific needs of older women who work in forestry should also be considered, as changes in physical abilities associated with ageing can vary by gender and can affect women in particular (ILO, 2019e).

For older workers who are no longer willing or able to continue performing the most strenuous and physically demanding tasks, it may be possible to

find alternative employment opportunities to extend their working lives. Some workers engaged in particularly hazardous work, such as forest-fire fighters, benefit from a lower retirement age to mitigate potential safety risks.

Photo 7. Mechanization is a reliable way of reducing accident rates and one way of attracting young workers to the sector.

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3.2. GENDER

While work in forestry is traditionally male-dominated, women participate in forestry activities in various ways, including silvicultural activities, and by collecting, processing and selling wood- and non-wood forest products. Women also frequently work as farmers, technicians, administrators, researchers and professionals throughout the sector. Their customary roles in forests, including those undertaken by indigenous women and in community forestry, are essential in areas such as traditional forest management and climate action. Furthermore, women are often key custodians of traditional and ecological knowledge regarding forest management and conservation (Castañeda *et al.*, 2020).

Despite this, women remain underrepresented in most areas of forest work, for instance in logging and in management decision-making roles throughout the industry (including forest authorities, enterprises and industry bodies, forest-based processing and manufacturing industries, and international trade groups). Barriers to women's participation in the workforce often stem from perceived physical capabilities and persistent stereotypes about forestry work, particularly logging being a solely male domain (Wilson, Ambrose-Oji and Ferranti, 2017).

The limited availability of gender-disaggregated employment and accident data in the sector makes accurately assessing women's contributions to, and level of risk in, the sector challenging (Garland *et al.,* 2020). However, it is estimated that women account for 25 percent of forestry workers at the global level and approximately 20 percent in Europe. In some countries, women comprise a much higher proportion of the workforce. For instance, women and girls are often the primary fuelwood collectors in many regions and countries including in sub-Saharan Africa and China, and in some countries, women are responsible for an estimated 80 percent of unpaid fuelwood collection (ESMAP, 2020; ILO, 2019f). Women are often overrepresented in unpaid and low-paying jobs including in the informal economy, and they face several other challenges including limited access to land ownership and to productive resources.

The participation of women in the sector brings about specific considerations from the perspective of OSH. While the physical demands of various tasks and occupations typically assigned to women are often lower than those assigned to their male counterparts, they nevertheless come with their own safety and health challenges. In the same way, women's increasing participation in male-dominated tasks is associated with specific challenges..

Non-wood forest products and fuelwood collection, which is often done by women and girls, involves heavy lifting, ergonomic issues and is time-consuming work. It can expose women to safety and health issues such as fractures, repetitive strain injuries, back disorders and miscarriages (Rojas, Schmitt and Aguilar, 2015), and natural hazards such as falling trees and branches which can cause serious injuries and fatalities (Garland *et al.,* 2020). Also, women often work in tree plantations and play an active role in reforestation and other silvicultural activities such as nursery work, that can involve heavy labour and frequent exposure to chemicals (ILO, 2019a). Work is often done outdoors or in greenhouses, subjecting workers to both heat and chemical vapours. Sufficient rest periods in cooler locations with the ability to rehydrate are therefore required. In these situations, women, particularly those who are pregnant or are lactating mothers, are confronted with additional risks that require specific OSH attention.

In many cases, work processes, tools, machines and other equipment are designed with an average-sized male worker in mind. Consequently, work

tools such as chainsaws may be more difficult and dangerous to operate with smaller hands and different physiques. In addition to having the appropriate equipment, it is important to provide separate facilities including lavatories, washing facilities and changing rooms for both women and men.

A similar issue arises in respect of PPE, such as safety boots, protective clothing, helmets, goggles and earmuffs, which may not be available in appropriate sizes for women workers (ILO, 1998). PPE that does not fit properly is a major safety risk for any worker as it may impede movement and vision; it may also mean that certain safety features do not function (Tamers, Streit and Pana Cryan, 2020). Furthermore, PPE that is uncomfortable, ill-fitting or accentuates risk factors is less likely to be used. As such, PPE should not only be designed with different user groups in mind including women, all workers should have access to good-quality and fit-for-purpose PPE and adequate information on how to use it.

Gender-based violence can also be a risk in forestry activities and is a particular issue for women working in the informal economy. Collecting non-wood forest products and fuelwood, often alone and in remote forested areas, can expose women and girls to violence and harassment (see ILO Violence and Harassment Convention, 2019 (No. 190)). Indigenous women, and women working in situations where resources are scarce or land ownership is unclear, are often at further risk (Castañeda *et al.,* 2020). While women are at greater risk of violence and harassment, there are also risks for men employed in forestry. Some forestry activities, particularly logging, can take place in dangerous areas and in places where illegal logging activities or conflicts over resources can increase the risk of violence towards all workers (FLEGT, 2021). Similarly, women and men who work to defend forest areas from deforestation and other illegal activities, including rangers and non-governmental organization workers, risk being subjected to violence (Walker, 2020; HRW, 2019; Nuwer, 2016). For example, between 2009 and 2018, almost 900 wildlife rangers were killed on the job worldwide (Belecky Singh and Moreto, 2019).

Box 4.
Occupational safety and health, and women in forestry

Ensuring a gender-responsive approach to formulating and monitoring OSH legislation, policies, programmes and preventative measures to reduce gender inequality is best facilitated by:

- carefully exploring the links among gender roles, safety and health in forestry;
- separately analysing risks to both female and male workers;
- collecting and developing gender-disaggregated OSH data with gender-sensitive indicators;
- incorporating the findings from research into policymaking and workplace action;
- fully involving both female and male workers as well as their representatives in the decision-making processes that affect their safety and health at all levels;
- ensuring gender-sensitive OSH information, education and training;
- designing work equipment, tools and PPE for both men and women; and
- ensuring gender-responsive working time arrangements and promoting work-life balance.

In particular, empowering women and increasing their participation in decision-making can make an enormous difference. Greater inclusion of women in education, professional training, safety training courses and decision-making can considerably reduce the number and degree of occupational hazards, which will have flow-on benefits to the rate of workplace accidents. It can also create significant personal and professional development opportunities for women, generating important spill-over benefits for their households and communities.

Source: Garland, J., Cedergren, J., Eliasson, L., van Hensbergen, H., McEwan, A. & Wästerlund, D. 2020. *Occupational safety and health in forest harvesting and silviculture – A compendium for practitioners and instructors*. Forestry Working Paper No. 14. Rome, FAO; and ILO. 2013. 10 Keys for Gender Sensitive OSH Practice – Guidelines for Gender Mainstreaming in Occupational Safety and Health. Geneva, ILO.

Photo 8. Women doing silvicultural work in South Africa. Heat stress is a factor to be considered when protective clothing for chemicals is used.

© Andrew MacEwan

In some regions, women face challenges in accessing both formal and informal forestry training. Vocational skills and safety training is often unavailable. When it is provided, it may not be gender responsive or it may lack gender-specific tailoring, potentially leaving women exposed to an increased risk of accidents. Governments, employer and worker organizations as well as other forestry stakeholders can promote opportunities for women to participate in forestry by increasing their efforts in providing gender-responsive training and job placement as well as by promoting women's skills (FAO, 2006). Safety and health risk assessments and workplace design must be adapted to accommodate the diversity of physical capacities of both women and men. Furthermore, women should be encouraged to participate in OSH committees and other decision-making bodies. Promoting the participation of women in social dialogue and other negotiation processes can improve the voice and representation of women; it can empower women and increase their visibility in forestry, which contributes to the legitimacy, credibility and effectiveness of these processes and improve working conditions for all. Social dialogue can contribute to

Photo 9. A field course in South Africa. In many regions, there is a shortage of training facilities and opportunities. This is especially true for women.

making the work in the sector more appealing to women and mitigate labour shortages in the future. In some regions, cultural barriers as well as legal and social norms prevent women from participating in forest user groups, producer organizations, trade unions or other decision-making bodies. This often stems from rules that only permit one person – usually a man – to represent a household, a symptom of wider gender-based discrimination. When women do participate in these organizations, they often are less likely to hold leadership and management positions.

Developing a better understanding of the role of women in forestry is essential to securing safe working conditions and for promoting opportunities for women, while simultaneously addressing specific OSH risks. Particular attention should be given to activities related to non-wood forest products and other areas in which women are particularly active. Enhancing the availability and coverage of data can help to increase the understanding of challenges and opportunities that women in the sector face and facilitate better-targeted policy responses that are more inclusive and deliver more effective outcomes for all.

3.3. MIGRANT WORKERS

While few reliable data are available for the migrant workforce in forestry, 12 million migrant workers, 7.1 percent of all migrant workers, are employed in the combined agriculture, forestry and fishing sectors globally (ILO, 2021c). Destination countries benefit from the skills and experience of migrant forestry workers who contribute to economic growth and development, while their countries of origin benefit from remittances and new skills acquired abroad by returning migrants. However, the migration process simultaneously creates complex challenges in terms of governance, protection of migrants and international cooperation (ILO, 2021d).

In rural areas, where most forestry activity takes place, migrant workers may be exposed to exploitation, discrimination and abuse. Migrant workers are more likely to work in vulnerable situations and face decent work deficits, including having access to limited or no social protection. In some cases, migrant workers in rural economies can be vulnerable to unethical recruitment practices, forced labour and human trafficking (ILO, 2019g).

While the number of migrant workers in forestry varies by country, in some countries and tasks they play a key role. In the United States of America, much of the forestry workforce is composed of migrant workers from Latin America, many of whom belong to indigenous populations. Migrant workers are also common in many European countries, including Finland, Germany and Sweden, where they are engaged in activities such as logging, silviculture and in collecting non-wood forest products. In some cases, they fill labour market shortages arising from difficulties in attracting local workers (Skill Shift Initiative, 2020). Meanwhile, internal migration for temporary forest jobs is common in countries such as Argentina (Albertí, 2017).

Migrant workers in forestry are often engaged in physically demanding and labour-intensive tasks such as planting, cutting and weeding, or collecting and selling wood-fuel or charcoal, frequently exposing themselves to OSH hazards and risks. Migrant workers often have poorer safety and health protection and worse working conditions than other workers (ILO, 2019c). Regardless of the nationality and status of workers, the same levels of safety, health and other criteria associated with decent work should be guaranteed for all. To this end, promoting effective and high-quality labour inspection systems is essential (ILO, 2005).

Migrant workers often rely on their employers for information, accommodation, transportation and other services, particularly in logging operations organized around work camps in isolated areas. These work camps often have poor living conditions that lack basic services and medical treatment options and may not be equipped to deal with any serious accidents that occur. Being away from home, family and friends for long periods in a distant place can also be a source of mental strain. This became a particularly critical consideration during the COVID-19-related restrictions on movements (ILO, 2020b).

Migrant workers may lack access to information or awareness of regulations and legislation related to OSH including information related to the rights and responsibilities of workers and employers. This may be because information is unavailable in a language that the worker understands or because the worker does not know where and how to access it. Similarly, information about rights to social protection and health care may not be readily accessible and, if an accident occurs, insurance and compensation mechanisms may be unavailable and claims may be complex (often prohibitively so). When labour rights violations happen, workers may be reluctant to report them for fear of losing their jobs, they might not know where or how to report them or they might lack the necessary language skills. In some countries, migrant workers do not have the right to join trade unions and are not covered by labour legislation, including laws governing accident compensation and other aspects of OSH. Their lack of representation and right to organize further exposes migrant workers to risks and vulnerabilities, leaving them in a weaker position than local workers when it comes to defending their rights and being able to fulfil their responsibilities (ILO, 2005).

The lack of appropriate OSH training presents a major challenge for migrant workers involved in forestry. Training can be limited in terms of both quantity and quality, sometimes due to working arrangements, but also due to barriers to training such as language or literacy skills (ILO, 2019g). In Sweden (Prevent, 2021) and Switzerland (SuvaPro, 2018), training materials are provided in a largely visual format that helps overcome these barriers to learning. Additional challenges for skills development for migrant workers include the recognition of foreign training qualifications, skills certificates and OSH risks that arise from differing national requirements and standards. Differences in OSH standards mean that migrant workers may need to pass a formal assessment to demonstrate their competencies in their destination countries (ILO, 2019f).

Refugees

In refugee camps and settlements, people often rely on the natural resources available to them. Consequently, many refugees living near forests rely on forest products for their livelihoods. While water, food and basic shelter are sometimes provided for displaced populations, there is often insufficient access to resources such as firewood and energy (Castañeda *et al.,* 2020). In addition, wood is required for construction and has other uses in camps, linking the challenge of ensuring decent livelihoods in refugee camps to forestry (FAO and UNHCR, 2018). This creates pressure on nearby forests. Estimates suggest that 85 percent of displaced populations in camps burn biomass such as firewood for cooking, with girls and women often responsible for collecting materials from the vicinity, which also contributes to forest degradation and deforestation (Forest News, 2020; FAO and UNHCR, 2018). Refugees who

rely on firewood as a fuel source may spend upwards of 20 hours per week collecting it, which can be an obstacle to attending school or to earning an income (UNHCR, 2019). This entails health and safety risks, including hazards from the local environment and exposure to sexual and gender-based violence, particularly for girls and women.

Photo 10. The inside of a modern harvester.

© Komatsu Logging

4. Technological developments

Technological developments including the mechanization and digitalization of production are among the key drivers of change for the future of work in forestry. They can play an important role in improving OSH and increasing the attractiveness of work in forestry, while generating productivity gains and enabling sustainable forest management. New technologies can be used to reduce the risk of forestry workers being exposed to hazardous situations but also introduce new hazards in their operation, bringing about both new opportunities and challenges for OSH.

Technological progress and related productivity growth, together with social dialogue, can contribute to decent work, ensure dignity and self-fulfilment for workers and lead to a more equitable sharing of the benefits for all (ILO, 2019b). While new technologies can have considerable benefits, they are often costly and may not be available to workers and enterprises in all regions. Uneven distribution of technology can exacerbate existing inequalities in the sector. Therefore, there is a need for technological solutions accessible and available to those with limited resources and for training in their correct use.

Mechanization

The increasing mechanization of harvesting and silvicultural operations, enabled by technological developments in motor-manual operations, have resulted in major reductions in forestry accidents (Garland, 2018). The mechanization of forestry activities is expected to continue around the world, although the nature of the mechanization will depend on factors such as the type of forestry operations, logging conditions and prevalent socio-economic conditions. For example, the use of tethered machines and improved remote cameras in cable yarding systems have improved safety in operations in steep terrain, which is traditionally a high-risk environment (US Forest Service, 2015).

Chainsaws remain the single most dangerous tool in forestry (Visser and Stampfer, 2015) and their use is linked to OSH risks including laceration and loss of limbs and health conditions such as hearing loss, whole-body vibration syndrome, traumatic vasospastic disease and musculoskeletal disorders (UNECE and FAO, 2020). It is expected that they will continue to replace manual tools in most places where they are still used.

Greater mechanization of both logging and silviculture will require expensive equipment, development of technological systems and investment in training for supervisors and workers. This may be prohibitively expensive for many enterprises, particularly small and medium enterprises (SMEs) and own-account workers, in many countries and regions. Mechanization changes the composition of tasks in a given occupation and is likely to increase the demand for qualified workers. Meanwhile, automation of traditional work and the skills gap created by emerging technology can generate both unemployment, labour shortages and productivity gaps where upskilling and reskilling opportunities are not provided.

Robotics

The last decade has seen major progress in the use of robotics in forestry applications (Visser and Okey, 2021). This includes advances in remote-controlled and autonomous harvesting (Forest Machine Magazine, 2020), forwarding (SCA, 2018; Ringdahl, 2011) and transport systems. It is likely that more commercially viable equipment will enter the market by 2030 and be increasingly more widely used in the sector, particularly in planted and intensively managed forests.

Photo 11. An experimental machine for fully autonomous or remote-controlled extraction of logs.

© Ola Lindroos

Remote-controlled machines will be operated from locations outside the forest with operators housed in climate-controlled and comfortable workstations, shielded from the vibration, noise and risks associated with tree felling. Use of these machines will reduce chainsaw felling and its associated risks. They will provide opportunities to work in areas that are not safely accessible to human operators and reduce the risks associated with harvesting on steep slopes. New jobs in forestry associated with the maintenance, repair and recovery of these machines will be created and will range from drivers through to technicians responsible for maintaining the onboard computer systems. This can create new OSH risks by placing workers who have little or no experience in forestry work into forest operations and workplaces. To reduce OSH risks, it will be necessary to establish and adhere to clear codes of practice for technicians and support staff who may lack experience in forestry work. When machinery is faulty, it is important not to take unnecessary risks to recover and repair the equipment, particularly when it is dangerous and/or difficult to reach places. These workers will need to be trained, not only in the specifics of forestry work but also more generally to learn about the risks of outdoor work and natural hazards. New office jobs will also emerge in the sector including the remote operation of machines and alongside these jobs there will be new OSH risks.

Battery-powered hand tools

Recent progress in battery technology has enabled the production of more powerful battery-powered tools for forestry work (Colantoni *et al.,* 2016). Battery-powered options now exist for tools such as brush cutters, pole pruners and chainsaws. While battery-powered chainsaws cannot yet compete with petrol-driven saws for prolonged periods of felling large trees (Bowes, 2020), technological developments and the increasing energy density of batteries (kWh/Kg) means that this is likely to change (CleanTechnica, 2021). Battery-powered chainsaws can already provide a viable alternative for small-scale forestry operations (Poje, Igor and Matevz, 2018) and smaller timber work (Colantoni *et al*., 2016).

Electric motors are significantly quieter (-10db) than their petrol counterparts (Colantoni *et al.,* 2016) and may reduce the need to wear ear protection when using them for short periods (Fink, 2017). The vibration of the battery-powered chainsaws is also notably lower than that of comparable petrol-driven models, therefore reducing the risks of vibration-induced health conditions in the hands and arms (Colantoni *et al.,* 2016). Battery-powered models are also lighter, which can reduce fatigue and musculoskeletal stress along with their associated problems. This could also offset some of the issues that arise in the sector, particularly in relation to age and gender. Furthermore, widespread use of battery-powered hand tools reduces the exposure of workers to vapours, fumes and smoke from the fuel and exhaust emissions generated

by petrol-driven tools, and their associated risks. In addition, it eliminates the risks associated with transporting and storing flammable fuels.

Since battery-powered tools are lightweight and quiet, this could create misconceptions regarding their safety, leading them to be considered less dangerous or treated with less caution than previously used tools. A more casual approach to work with these tools by operators could lead to accidents and injuries.

Digitalization, information and communication technology

Digitalization and ICT, including artificial intelligence and remote sensing, have the potential to transform many aspects of forestry work.

Big data processing may enable continuous analysis of issues such as working environments, operator behaviour and machine applications. When paired with big data processing, real-time monitoring and assessment will enable improvements in operational efficiency and in further identifying unsafe practices. The use of technologies such as geographic information systems (GIS) and telematic applications alongside big data can help capture and record OSH risks for analysis to improve working environments.

Technologies such as augmented reality have been developed to improve training by using a simulated environment to allow workers to virtually practice new and challenging tasks so they are better prepared and have improved safety awareness in the workplace.

Photo 12. Training for mechanized harvesting in South Africa using a simulator.

There is also increasing application of ICT in forestry in real-time, both in terms of the automation of certain activities, as already discussed, and also to support other activities particularly in optimizing harvest and transport operations.

Smart clothing
Advances in integrating a variety of sensors into work clothing and PPE means they will soon be used in operational systems specifically targeting health and safety issues. These include systems designed to detect extreme body temperatures (Edirisinghe, 2015), cameras integrated into work clothes to record and assess incidents, or global positioning system (GPS) transmitters capable of warning workers if they are entering unsafe areas (Proximity Warning, 2021). Wearable technologies such as actigraphy, which monitors activity and rest cycles, can help prevent workers from overexerting themselves and suffering from accidents or injuries related to fatigue or lapses in concentration.

Fatigue detection systems
Fatigue is among the highest risk factors related to OSH. Systems to detect fatigue in drivers based on eye movement analysis are increasingly being incorporated into vehicles. Also, systems aimed at detecting fatigue by employing a range of methods are being incorporated into PPE. This includes smart helmets (Li *et al.*, 2014), smart clothes and smart glasses (Chang, Chen and Chiou, 2018). Further development work could result in smartphones that are able to detect fatigue (Karvekar, 2018).

Lone worker alarm systems
Lone worker systems are designed to keep track of a worker's location and to trigger an alarm under certain circumstances (UKFISA, 2021). These can include both passive systems, in which an automatic alarm will be triggered if a worker becomes incapacitated, and active systems requiring workers to check in regularly or raise an alarm if in difficulty. These systems can use either mobile phone networks or satellite communications and usually incorporate GPS receivers to indicate precise locations.

Health and safety recording systems and emergency support systems.
Various systems for online and offline real-time reporting of incidents, as well as services providing geolocation, are in use in forestry (Notify, 2021). These systems have the potential to improve OSH and accident response times in forestry operations but may depend on the availability of relatively advanced technology and network coverage.

Smartphones are increasingly used to support health and safety functions

for organizations and workers. These include first-aid applications that can be accessed using a smartphone; while they can never replace trained staff, they can help save lives. Furthermore, remote diagnosis and support systems that have been developed to meet the immediate needs of the COVID-19 pandemic will become increasingly operationalized in other contexts and are likely to be used in forestry work.

Health and safety checklists for forestry sites are already provided by various industry stakeholders (Safety Culture, 2021). Safe procedure checklists for individual activities are likely to become commonplace and may be particularly useful for activities that occur infrequently.

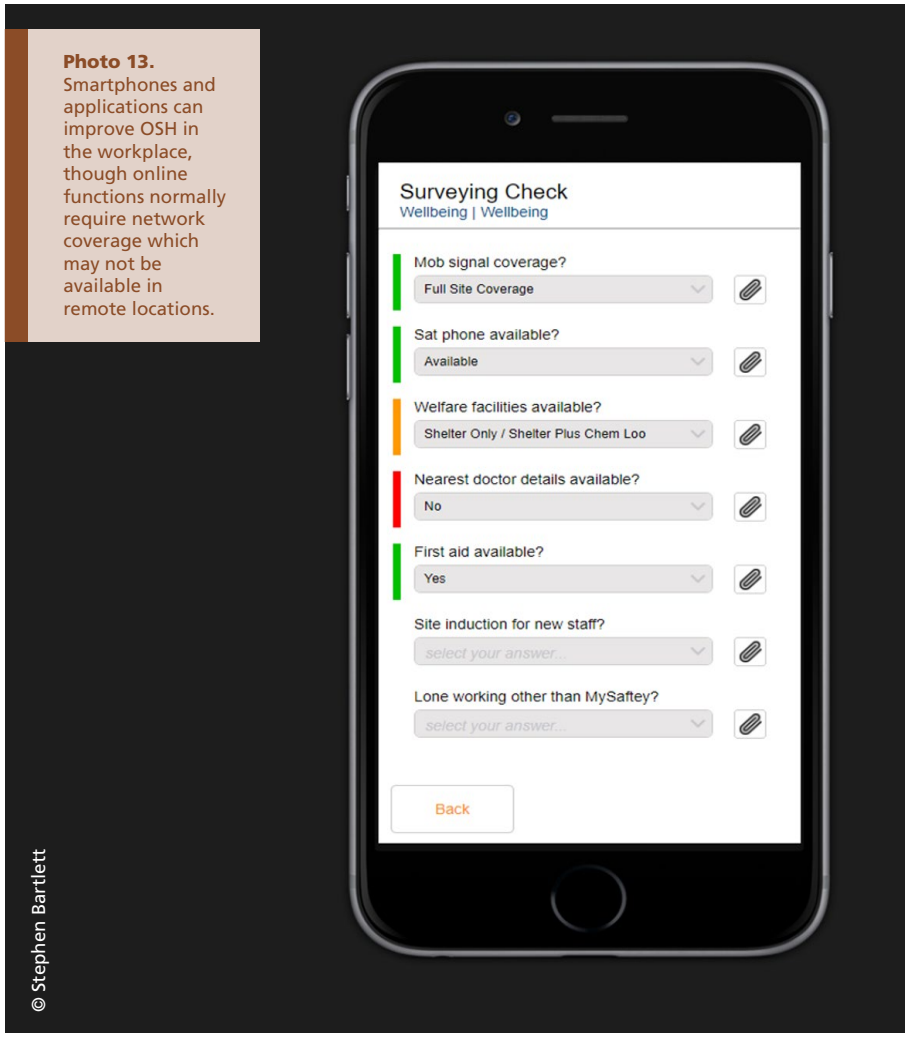

Photo 13. Smartphones and applications can improve OSH in the workplace, though online functions normally require network coverage which may not be available in remote locations.

Information technology tools

Information technology tools were first introduced into forestry operations decades ago to provide static solutions to problems such as optimizing harvesting schedules (Hotvedt, 1983), transport (Sessions, 1987), log bucking (Maness and Adams, 2007) and modelling fire behaviour (Rothermel, 1972) to help estimate hazards (Keane *et al.,* 2010; Parajuli *et al.,* 2020) and assist in fire control. In the last twenty years, there has been an increase in real-time solutions to these problems provided by systems integrated into field equipment (Labelle and Huss, 2018) and able to respond to changing needs as they occur.

These technologies continue to develop with the use of blockchain technology, for example in forest supply chains, and are used for verifying carbon claims (Howson *et al*., 2019).

Furthermore, the increasing sophistication and availability of mobile computing (smartphones in particular) enable forestry tasks such as compiling inventories to be carried out with lower error rates (Lindberg, 2020). The incorporation of Lidar, a remote sensing method that uses light in the form of a pulsed laser to measure ranges (variable distances) to the Earth, allows data to be readily transferred from scanners into handsets.

Remote sensing technologies

Smart forests

Sensors are increasingly located both inside and outside forests to deliver information to remote locations. This flow of information allows for control over forest resources to be transferred from local actors to remote actors (Gabrys, 2020). This can have both positive and negative impacts on safety and health both for workers and local populations in general. On the one hand, remote control of forest resources could affect the livelihoods of local populations who currently manage them while on the other hand, remote sensing could strengthen OSH practices and may improve the situation of workers.

Drones

Geospatial technology supported by drones, including through compiling information on topography, is increasingly used in forestry operations. Advances in the use of this technology could help: improve road planning and alignment, identify landings and ridges for timber hauling, and find suitable locations for cable yarders and for placing smaller equipment.

Furthermore, drones will be increasingly used to assess OSH risks such as the accessibility of areas after storms and to investigate accidents. The versatility of drones means that they can be deployed in forest fire monitoring and management systems, help to provide data on wildfires and assist in

containing wildfires even in remote locations. A reduction in the size and duration of fires would reduce risks for workers, fire fighters and local populations. Automated systems for detecting fire have been used in forestry for many years and have proved useful in areas where fixed points provide a view over a forest. Recently, a wide range of drone-based fire detection and management systems have been introduced, some of which can operate autonomously. These rapid developments can result in much greater efficiency in fire control and lead to significant reductions in both the size and duration of fires which in turn reduce the risks for firefighters as well as workers and local populations caught in a fire's vicinity (Akhloufi, Couturier and Castro, 2021).

Drones can be useful tools for extending visual supervision which could improve the quality of operational planning, inventory management and various other supervisory tasks, helping to study work behaviour and ensure safe practices. Furthermore, they can also be used to support labour inspectors and help them to access remote and isolated areas. This increased monitoring of the work environment can also lead to increased anxiety and other psychosocial issues for workers.

5. Other labour-related issues impacting occupational safety and health in the future of forestry work

Work arrangements in forestry

Work in forestry is based on various types of work arrangements with permanent full-time formal employment being less commonplace. These arrangements include self-employment (including private forest owners), the prevalence of contractors and sub-contractors (for example, individuals with chainsaws offering their services), casual work, piece rate work and seasonal employment. Workers can work long shifts in forest concessions, sometimes involving long-term accommodation in work camps. Furthermore, a significant amount of forest work is undertaken on a part-time basis with workers seeking to complement their income from other activities such as agriculture. As megatrends and drivers of change shape the future of work in the sector, there will likely be an increase in the use of a diverse range of work arrangements.

The work arrangements used in forestry can exacerbate decent work challenges in the sector (ILO, 2019a). Seasonal, temporary, part-time and contractual work may in some instances be inadequately covered by labour regulations and inspections, and workers may lack access to social protection. Temporary and seasonal workers may be more exposed to various types of safety hazards such as difficult working conditions and repetitive tasks (Jones *et al.,* 2020) related to a higher risk of accidents and injuries, psychosocial issues, harassment and fatigue (ILO, 2019e).

Forestry workers are usually either directly employed by a company or indirectly employed by contractors with a general trend towards the increased use of contractors and sub-contractors (FAO, 2011). As stated in the ILO code of practice for safety and health in forestry work, the same safety and training requirements should apply to all workers, including contractors and their workers (ILO, 1998).

Piece pay rates, where remuneration is determined solely by the unit output of each worker or team, is common in forestry. This may lead workers to engage in long working hours and risky behaviour that can be detrimental to

both their physical safety and health (Johansson, Rask and Stenberg, 2010). According to the ILO guidelines for labour inspection in forestry, "under no circumstances should the payment system encourage workers to take risks or to engage in unsafe work to meet production targets" (ILO, 2005).

Much forestry work takes place in the informal economy. This often leaves workers less protected than in the formal economy, as they may work in informal enterprises or as unregistered informal workers. Decent work deficits such as poor and unsafe working conditions, obstacles to the right to freedom of association and the effective recognition of the right to collective bargaining, inadequate occupational safety and health measures, low productivity, low wages, and a lack of access to social protection are commonplace for workers in the informal economy in forestry (ILO, 2019f). Cooperatives and other forms of forest owner and producer organizations can promote adequate OSH measures by providing PPE and training on their appropriate use, and by supporting the formalization of workers and economic units.

While issues related to mental health and psychosocial risks at work have been raised on OSH agendas in certain regions (EU-OSHA, 2019), these have not always been effectively communicated or acted upon. The COVID-19 pandemic increased psychosocial work-related risks with increased workloads and longer working hours in many cases, isolation, pay cuts, lay-offs and reduced benefits. This highlights the need to ensure attention to accidents but also to other work-related health issues impacting the well-being of workers.

Social dialogue based on respect for freedom of association and the effective recognition of the right to collective bargaining is key to promoting decent and sustainable work, including safe and healthy working conditions in forestry (ILO, 2019a). Effective OSH systems and compliance with OSH require worker involvement, including through workplace committees on OSH. This is true for workers in all types of working arrangements, however, work arrangements such as self-employment and temporary, casual and piece work create challenges to the organization of workers and employers and the coverage and effectiveness of traditional industrial relations systems (ILO, 2019f). The high prevalence of SMEs, work in the informal economy, and the seasonality and geographic isolation that characterize the sector contribute to these challenges. In any situation, workers should have the right to know of potential hazards, the right to remove themselves if in imminent danger and the right to refuse unsafe work (ILO, 2016).

International labour standards lay down the basic minimum social standards for decent work agreed upon globally by governments, workers and employers, and these provide a normative framework for OSH. While there is no specific international labour standard on forestry, many ILO Conventions and Recommendations, as well as the fundamental principles and rights at work, apply to forestry (see Box 5). Furthermore, the ILO also has specific guidance on safety and health and on labour inspection in forestry, which can provide additional guidance to the sector.

Box 5.
International labour standards relevant to occupational safety and health in forestry

A safe and healthy working environment is one of the five categories in the ILO Declaration on Fundamental Principles and Rights at Work (1998), as amended in 2022. This Declaration commits Member States to respect and promote principles and rights in these categories, whether they have ratified the relevant conventions or not. These categories are:

- freedom of association and the effective recognition of the right to collective bargaining;
- the elimination of all forms of forced or compulsory labour;
- the effective abolition of child labour;
- the elimination of discrimination in respect of employment and occupation; and
- a safe and healthy working environment.

The following standards are among those directly relevant to OSH in forestry:

- Safety and Health in Agriculture Convention, 2001 (No. 184), and its accompanying Recommendation (No. 192);
- Occupational Safety and Health Convention, 1981 (No. 155), its accompanying Recommendation (No. 164) and its Protocol of 2002;
- Promotional Framework for Occupational Safety and Health Convention, 2006 (No. 187) and its accompanying Recommendation (No. 197);
- Occupational Health Services Convention, 1985 (No. 161) and its accompanying Recommendation (No. 171);
- Chemicals Convention, 1990 (No. 170);
- Working Environment (Air Pollution, Noise and Vibration) Convention, 1977 (No. 148); and
- Violence and Harassment Convention, 2019 (No. 190) and its accompanying Recommendation (No. 206).

In addition to the International Labour Standards, the ILO has developed the following forestry-specific tools in a tripartite manner:

- Guidelines for labour inspection in forestry (ILO, 2005)
- Code of practice on safety and health in forestry work (ILO, 1998)
- Code of practice on safety and health in agriculture (ILO, 2001)

Micro, small and medium forest enterprises

The organization of forest enterprises is evolving as larger forestry companies have merged, downsized, relocated, restructured or ceased operations. In some regions, much of the work formerly performed by larger enterprises, particularly in harvesting, has been outsourced to a rapidly growing number of smaller contractors. The creation of an enabling environment for enterprise development is an important step towards sustainable enterprises in forestry.

Micro, small and medium forest enterprises (MSMFEs), ranging from one-person operations to firms of up to 100 employees, make up most of the enterprises in the sector and employ most of the workforce. MSMFEs operate in both the formal and informal economy (ILO, 2019f). Private forest owners working with chainsaws, sometimes alone, are a high-risk group for accidents and, in some countries, have accident rates ten times higher than those of forestry employees in the formal economy (Lindroos and Burström, 2010). These high accident rates occur largely due to inexperience and lack of training as well as to the unavailabilityof, lack of access to, or non-use of, appropriate PPE. In addition, labour inspection systems are often weak in many countries where MSMFEs are particularly prevalent, making it a challenge to monitor working conditions.

In some countries, extension and rural advisory services may have appropriate specialists to provide training in safe and healthy working methods to forestry workers. Also, forest owners, often not properly trained or experienced, have the option to collectively hire well-trained professional workers from producer organizations for harvesting work.

In high-income countries, forest owners without adequate training can engage professionals from an official body such as a forest owner association or undertake a training programme themselves. Training programmes and their providers can provide such training to forest owners.

Concession forestry

Forest concessions continue to be an important means for granting rights to public forests in the boreal and tropical regions (van Hensbergen, 2018). Over the next few decades concessions of natural forests are likely to continue on a large scale but they will be confined to ever more remote areas, often with more challenging working conditions. Large-scale concession forestry, however, is likely to become less common in tropical areas, leading to a reduced need for workers in these regions. Those retained in their jobs are likely to be the most experienced workers. Even among this group, very few have formal training.

Work camps remain common in concession forestry in certain regions and while their presence can enhance job opportunities for local populations, they can also create OSH risks for workers because of low quality and cramped housing, and psychosocial issues stemming from isolation and being away

from families. Substance abuse in the camps can also be a problem (Verité, 2020). Due to their often temporary and remote location, work camps tend to lack health care services and labour inspections rarely reach them.

In some countries, the rights to manage forests are increasingly being transferred from central governments to local actors, often communities and smallholders including indigenous populations (Rights and Resources Initiative, 2021). In some regions, they often lack information and access to PPE and as such are at higher risk of injury. In addition, equipment used by operators is often obsolete or worn out. For example, chainsaws with ineffective chain brakes or vehicles transporting timber that are poorly maintained and unfit for purpose. Adequate training and provision of information are key to addressing these issues, alongside ensuring fair incomes for small operators who can then make investments to improve OSH and productivity where needed.

Forest management certification

Forest management certification schemes are increasingly used to promote responsible forestry practices. Unlike national labour laws and regulations, which are enforceable and often based on international labour standards, forest management schemes are voluntary and are not legally binding. In 2021, an estimated 460 million hectares of forest were certified under the Forest Stewardship Council (FSC) (FSC, 2021b), the Programme for the Endorsement of Forest Certification (PEFC) (PEFC and FSC, 2020) or both (PEFC, 2021), that is 11.5 percent of global forest area and approximately 30 percent of commercial forest area.

Certification schemes remain heavily concentrated in areas containing boreal and temperate forests, with only 15 percent of FSC-certified forests in tropical regions. Certification schemes can provide incentives to improve forest management practices and provide access to new markets. The main certification schemes also include selected provisions on labour-related aspects and OSH, including the FSC (2021a) and initiatives such as the Forest Law Enforcement, Governance and Trade (FLEGT). Such efforts cannot replace the effectiveness of public governance systems but can support and/or supplement them. While certification schemes can help promote improved working conditions and worker safety, it remains the duty of employers to ensure safe working environments and training for their staff.

Box 6.
Safety I and Safety II

Within the field of OSH, Safety I is considered the traditional approach to OSH, focusing on the absence of accidents and incidents, or in essence, seeing that as few things as possible go wrong. A traditional focus is placed on unsafe system operation rather than on safe operation. Safety II, on the other hand, focuses on as many things as possible going right and shifts the focus to safe operation. The traditional approach of Safety I can be said to be reactive, whereas the emerging Safety II approach is proactive, asserting that prevention is better than cure. The two approaches of Safety I and Safety II are not mutually exclusive, and in fact complement each other (Hollnagel, 2014).

Applying the Safety I and II theories and approaches has yet to have an impact on forestry. This could change in view of the increased use of information technology, which can improve the understanding of everyday functioning of the workplace and help implement a more proactive approach to OSH by using drones for example for workplace assessments and inspections. Following the Safety I and II concepts could help improve OSH management systems in the sector in the future.

6. Final remarks

The world of work is changing and the changes bring new OSH opportunities and challenges. Transformative changes driven by technological innovations, demographic shifts, climate change and globalization are affecting forestry, its workforce and OSH. In identifying and analysing the implications of some of these changes, opportunities and challenges in forestry work, this report aims to serve as a starting point for more research and analysis on this important issue.

Demographic changes such as ageing workforces, the reputational challenge of recruiting young workers to the sector and the increasing diversity of forestry workforces require special attention to effectively address current and future OSH challenges. Mechanization, as well as adopting other new and innovative technologies, will provide important opportunities for improving safety and health in forestry work. A safe and healthy working environment may contribute to enhancing the attractiveness of the sector and recruiting new workers.

Advanced technologies can require significant investment and entail challenges from a safety perspective as well as needs to provide high-quality life-long training and skills development opportunities to equip the sector's workforce with the necessary skills to work safely. Climate change will impact forestry work in numerous and diverse ways: from more frequent, severe and dangerous salvage operations caused by extreme weather events to the spread of pests and diseases. The principles of a just transition together with the promotion of decent work in the sector offer the best path forward to mitigate the impacts that these and other changes will have on the safety and well-being of forestry workers around the globe.

Forestry continues to face the challenge of overcoming high rates of accidents, illnesses and other occupational safety issues, some of which have been exacerbated as a consequence of the COVID-19 pandemic. While there have been notable improvements over the past decades, more needs to be done to address these challenges. Working together with a common purpose, governments, employers and workers are well-positioned to build a preventative safety and health culture based on international labour standards and to ensure that the future of work in forestry is safe and healthy for all.

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